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# California Regional Water Quality Control Board San Diego Region

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February 23, 2007

Office of the Assistant Chief of Staff,  
Environmental Security  
Attn: Mr. A.C. Entingh  
Environmental Compliance Branch Head  
Building 22165, U.S. Marine Corps Base  
Camp Pendleton, CA 92005

In reply refer to:  
LDU:06.0013.05:agrove

Dear Mr. Entingh:

**RE: CORRECTIVE ACTION PLAN PHASE 1 EXPANSION UNIT, LAS PULGAS LANDFILL, MARINE CORPS BASE CAMP PENDLETON, CA (REF: 5090.11, Ser ENVSEC/41, dated December 26, 2006).**

The California Regional Water Quality Control Board (Regional Board) has reviewed the "Corrective Action Plan, Phase 1 Expansion Unit, Las Pulgas Landfill, Marine Corps Base Camp Pendleton" prepared by Tetra Tech EC, Inc. (and dated December 26, 2006) for the purpose of complying with the requirements of Cleanup and Abatement Order R9-2006-0016.

The CAP referenced above contains very significant deficiencies in the level of technical information and geotechnical evaluations necessary to objectively evaluate the proposed Alternative Remedial Action presented by the U.S. Marine Corps (USMC) or the "Discharger." As a result of these deficiencies, the CAP fails to make the requisite demonstration, to support the proposed alternative remedial action, as required by Cleanup and Abatement Order No. R9-2006-0016 (CAO). The Regional Board finds that the CAP fails to comply with minimum requirements of CAO (Directive B.1.c), including:

- propose an alternative remedial action that affords equivalent protection against water quality impairment, as compared to Directives B.1.a. or B.1.b. of the CAO,
- propose an alternative remedial action that will result in compliance with all applicable requirements of CCR Title 27 and Order 2000-54 to the satisfaction of the Regional Board, and

*California Environmental Protection Agency*



- the CAP does not contain the required information described in Directive B.4 of the CAO

Based on these considerations, as detailed below, the Regional Board rejects the CAP for the purpose of complying with the requirements of the CAO. The deficiencies in the existing CAP are described in the following comments. The USMC should submit a replacement CAP proposing to implement corrective actions for either corrective construction (see CAO Directive B.1.a) or clean closure (see CAO Directive B.1.b). In the near future, the Regional Board will amend the CAO requiring that the USMC submit a replacement CAP (as indicated above) for the Phase 1 Unit at the Las Pulgas Landfill.

## GENERAL COMMENTS

1. **Continuing threat of pollution and nuisance.** The CAP's evaluation of the USMC's alternative remedial action does not adequately address the likelihood of continuing pollutant releases associated with the estimated 250,000 cubic yards of solid waste, currently located within the Phase 1 Unit. Pollutants from these solid wastes will likely migrate through the defective composite liner system and into the soils and ground water underlying the Phase 1 Unit. The municipal solid wastes present a significant source of pollutants, as summarized by information provided in Appendix A to this letter. The condition of the existing Phase 1 Unit composite liner system (with existing tears and holes) does not provide for an effective long-term waste containment system for the 250,000 cubic yards of solid wastes and their associated degradation products, including leachate and landfill gas, currently in the Phase 1 Unit.
2. **Future land uses for clean closure of Phase 1 WMU.** The CAP concludes (see text discussion on page 2-6): *"The CAO does not specify the future land use of the Phase 1 WMU footprint following clean closure. Following clean closure, the Phase 1 WMU footprint will become an unlined area or depression adjacent to existing wastes and future landfill cells."* The CAO does not affect future land use decisions that the USMC may make regarding the re-use of the clean closed Phase 1 footprint. The CAP incorrectly concludes that the clean closure of the Phase 1 Unit would somehow preclude the future construction of another lined waste management Unit on the footprint of the former Phase 1 Unit. However, it is the USMC's own land use decisions that would lead to the conditions described on page 2-6 of the CAP. The current Phase 1 Unit is located in the north east area of the Las Pulgas Landfill, and the CAO does not preclude the USMC from proposing a design to construct a new lined waste management unit in that area to replace the clean closed Phase 1 Unit.
3. **Geotechnical stability of propose remedial action.** The Regional Board has significant technical concerns about the short- and long-term stability of the

proposed remedial alternative, particularly since the CAP fails to indicate if the Phase 1 Unit would be buttressed prior to loading. The stability of the proposed remedial alternative would likely be most critical after loading due to saturated conditions on the initial operations layer located at the bottom of the existing Unit, and effects from differential settlement. The CAP fails to provide a complete technical evaluation of geotechnical stability for the proposed remedial alternative under static and dynamic conditions (e.g., from earthquakes). Also see Specific Comment Nos. 1 and 2 below.

4. **Cost effectiveness comparison between remedial alternatives.** From a meeting with the USMC staff on January 17, 2007, the Regional Board understands that the Phase 2 Unit is funded as a “design and build” contract at the Las Pulgas Landfill. From the description offered by the USMC, it appears that the anticipated schedule may allow for the Phase 2 Unit to be completed and available to receive wastes prior to the implementation of corrective actions for the Phase 1 Unit. It is not clear that it would be necessary to temporarily stockpile excavated solid wastes from Phase 1 at another location if the Phase 2 Unit is available to accept the excavated solid wastes for disposal. Corrective construction and clean closure appear to include tasks that could be avoided or are not needed if the Phase 2 Unit is available. Additional concerns and comments on proposed tasks and estimated costs are included in Specific Comment No. 6 below.
5. **Applicability of Federal CERCLA Guidance.** The CAP indicates that the evaluation conducted by the USMC used the EPA guidance for Conducting Remedial Investigations and Feasibility Studies under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) dated October 1988. The CERCLA statute and associated CERCLA guidance is only applicable to closed or abandoned hazardous waste sites listed on the National Priorities List (NPL) and regulated pursuant to CERCLA. As you know, the Final Record of Decision (ROD) for Operable Unit 2 (1997), signed by the parties to the Camp Pendleton Federal Facilities Agreement or “FFA”, removed the Las Pulgas Landfill from the Installation Restoration (IR) Program implementing CERCLA.

Currently, the Las Pulgas Landfill is an operating Class III (municipal solid waste) landfill that is regulated by waste discharge requirements issued by the Regional Board (Order 2000-54), and a solid waste facilities permit issued by the Local Enforcement Agency (on behalf of the California Integrated Waste Management Board). The Las Pulgas Landfill is subject to State regulatory requirements promulgated in California Code of Regulations Title 27 and Federal requirements in the Code of Federal Regulations, Title 40, Part 258.

6. **Citations of applicable State Regulatory Requirements.** The text of the cap incorrectly cites sections of CCR Title 23, Chapter 15. The correct citations of applicable requirements are found in CCR Title 27.

## SPECIFIC COMMENTS

The CAP asserts that the Alternative Remedial Action approach is essentially the same as a vertical expansion at an existing landfill (CAP page ES-1). However, vertical expansions, including construction of a liner system, have been built over older unlined landfill units, but liner systems were not required for the older original units. A vertical expansion is not typically built over a Unit with a failed/defective liner system and that is currently under a cleanup and abatement order. State and Federal requirements for composite liners at landfill cells/Units went into effect during the 1990's, well in advance of construction of the Phase 1 expansion Unit at the Las Pulgas Landfill. The USMC is obligated to ensure that required landfill liner systems at Las Pulgas are correctly constructed, and meet all the applicable regulatory and performance requirements.

In order to properly evaluate the relative benefits of the three remediation plans all pertinent aspects of each plan must be considered. The CAO (Directive 4) requirements for evaluation of an alternative remedial action for the Phase 1 Unit are summarized as follows:

- The CAP must provide an evaluation of all relevant technical and economic factors, and
- the CAP must provide a demonstration, acceptable to the Regional Board, that the proposed engineered alternative remedial action will promote attainment of all the applicable requirements of CCR Title 27 and Order No. 2000-54 and addenda thereto; and afford equivalent water quality protection as that provided under CAO Directives B.1.a. or B.1.b.

The CAP does not include analyses evaluating slope stability or differential settlement potential of the proposed design for the Alternative Remedial Action plan. The CAP states that settlement and slope stability analyses "will be performed." Considering the omission of essential technical evaluations and information (identified in General Comments above and Specific Comments below), the CAP fails to comply with the CAO requirements cited above.

The Regional Board has a number of significant concerns related to the lack of technical information included in the USMC's CAP, as well as the short-term and the long-term viability of the proposed engineered alternative remedial action. The details on these deficiencies are provided below:

1. **Foundation conditions: State Requirements.** The CAP fails to provide an acceptable level of engineering analysis or supporting information to make the requisite demonstration to the Regional Board.

The CAP does not include adequate information to evaluate if the proposed alternative design, including “*layers of geogrid*” above existing wastes, will meet the performance requirements for foundation required in CCR Title 27, §20240(d), as follows:

**“Unit Foundation**—All engineered structures (including, but not limited to, containment structures) constituting any portion of a Unit shall have a foundation or base capable of providing support for the structures, and capable of withstanding hydraulic pressure gradients to prevent failure due to settlement, compression, or uplift and all effects of ground motions resulting from at least the maximum probable earthquake [for Class III Units (see §20370)] or the maximum credible earthquake [for Class II Units (see §20370)], as certified by a registered civil engineer or certified engineering geologist. [Note: see also §21750(f)(5).]”

The foundation layer proposed by the Discharger in the original Report of Waste Discharge/Joint Technical Document (EMCON, 1998) specified a subgrade comprised of a graded bedrock surface---- not municipal wastes as proposed in the CAP. Additionally, the engineered alternative liner system currently described in Order 2000-54 must be “... installed in direct and uniform contact with the underlying materials” (Discharge Specification No. 32, Order 2000-54). Further, the “underlying materials” must meet the requirements for “Unit foundation” required in CCR Title 27, §20240(d) and meet the required stability requirements specified in CCR Title §21750(f)(5).

The Joint Technical Document or “*JTD*” (EMCON, 1998) for the Las Pulgas Landfill provides geotechnical information (see JTD Appendix H) as a basis for evaluating the stability and the liner system for the Phase 1 Unit. Construction of the engineered alternative liner system described in Order 2000-54 upon municipal solid waste (MSW) would be a significant departure from the foundation conditions for that liner system (including the Leachate Collection and Removal System or “*LCRS*”) as proposed to the Regional Board in the JTD (EMCON, 1998). The JTD reports that the MSW has significantly lower strengths characteristics than the bedrock beneath the Las Pulgas Landfill. According to the JTD (Appendix H: pages 6-2 and 6-3), the following strength parameters were used for the Las Pulgas Landfill:

Parameter	Bedrock Strength	Waste Strength
Unit weight ( $\gamma$ )	110 pcf	65 pcf
Cohesion (c)	1,150 psf	400 psf
Internal friction angle ( $\phi$ )	36°	20°

Pcf = pounds per cubic foot

Psf = pounds per square foot

It is not clear to the Regional Board that the remedial alternative design, as proposed in the CAP, would meet the required regulatory criteria for foundation strength and comply with the applicable performance requirements of CCR Title 27 and Order 2000-54 at the Las Pulgas Landfill.

**Geotechnical stability and waste containment function of proposed remedial alternative.** The CAP fails to provide adequate technical evaluation of effects from differential settlement of wastes or stability of the Unit under local ground acceleration conditions resulting from the maximum credible earthquake. These factors may significantly impact the following aspects of the proposed alternative remedial action:

- a. The short- and long-term stability of the proposed corrective action remedial liner design.
- b. The short- and long-term stability and functionality of the proposed LCRS located above the proposed alternative remedial action liner design.
- c. The long-term ability of the proposed remedial action design to comply with the required performance criteria specified in CCR Title 27 §20330 (liners), §20340 (leachate collection and removal systems or "LCRS"), §20365 (precipitation and drainage controls), and §20310 (waste management Unit standards), and CFR Title 40, Part 258 (§258.40).
- d. The CAP does not indicate if the USMC's preferred remedial action includes anchoring the "geogrid system" for long term stability of the proposed remedial design. This raised additional significant concerns:
  - i. If the geogrid system will be anchored, then the CAP fails to provide information on how this would effectively be accomplished, when the western side of Phase 1 is bounded by waste.
  - ii. If the geogrid system will not be anchored to the bedrock, then the CAP fails to provide information on how the combination of the geogrid system and underlying foundation (comprised of municipal solid wastes) will impart enough support and remain stable beneath the additional 100+ feet of solid wastes that the USMC plans to discharge into the Phase 1 Unit.
  - iii. The CAP does not provide an engineering analyses and supporting information for strengths of materials and stability of the proposed remedial design under static and dynamic conditions (as required by CCR Title 27, §21750(f)(5)).

- e. The CAP does not provide an adequate technical analysis of stability, prepared by a registered civil engineer or certified engineering geologist, indicating that :
  - i. the proposed design would achieve a factor of safety, for the critical slope, of at least 1.5 under dynamic conditions, and
  - ii. containing all of the information required by CCR Title 27, §21750(f)(5)(A through D).

2. **Evaluation of unstable areas: Federal Requirements.** The USMC's preferred remedial alternative includes construction of a second engineered alternative composite liner system, above existing wastes in the Phase 1 Unit. Under this condition, the preferred remedial alternative must comply with the Code of Federal Regulations (CFR), Title 40, Part 258, §258.15 (unstable areas). Construction of a new liner and Leachate Collection and Removal System (or LCRS) above existing wastes constitutes "*poor foundation conditions*" in the cited applicable regulations. The CAP does not include sufficient technical information for the USMC to make the requisite demonstration and provide the demonstration to the Regional Board; as required by CFR Title 40, Part 258, §258.15(a).

3. **Failure to remedial alternative to address defective waste containment system.**

Defects in the as-built liner system in the Phase 1 Unit are documented in technical reports prepared by consultants to the USMC and previously provided to the Regional Board (Brown and Caldwell, 2003 and ERRG, 2004a and 2004b), and described in the Technical Staff Report for Cleanup and Abatement Order R9-2006-0016 (available on-line at <http://www.waterboards.ca.gov/sandiego/orders/orders-06.html> ). The USMC's preferred remedial alternative ignores the likely scenario that defects in the existing basal liner system will only worsen when the additional waste load is placed upon the existing Phase 1 Unit. The defects in the waste containment system are associated with the existing liner system (created as a result of construction or operational related problems for Phase 1), the operations layer, and the prepared subgrade. At a minimum, the CAP ignores the long-term impacts from the following factors associated with the defective waste containment system for the Phase 1 Unit:

- a. Project specifications (prepared by EMCON) required the subgrade to be rolled to a smooth and level surface. The surface was to be free of stones greater than 0.5-inch diameter, and organics and other deleterious materials. The poor, rocky condition of the subgrade (with maximum rock size up to 8

inches) ensures that the tears and holes in the existing liner system (as documented by Brown and Caldwell Report (dated November 2003)) will only worsen when a greater volume of waste (load) is placed upon the existing liner system located in the Phase 1 Unit.

- b. Project specifications (prepared by EMCON) required the “operations layer”, placed immediately above the LCRS, to contain no more than 11% fines. According to the Engineering/ Remediation Resources Group (ERRG) Report (dated November 2004), the operations layer placed in the Phase 1 Unit is comprised of silty-fine sand with more than 42.5 % fines (passing No. 200 sieve). The results of the HELP model (see HELP Modeling Output attachments to CAP), performed to support the USMC’s preferred remedial alternative, ignores the presence of the operations layer containing elevated fines content or incorrectly characterize the “operations layer” as “sand” imparting a much higher permeability to the existing operations layer than suggested by the analyses reported by ERRG.

With the elevated fines content, it is likely that the existing operations layer has limited effectiveness in conveying leachate to the existing LCRS in the Phase 1 Unit. Under these conditions, a significant portion of the leachate generated by the existing 250,000 cubic yards of waste may be ponding upon the operations layer, and this ponding may have contributed to conditions resulting in the discharge of leachate from the south facing sideslope of the Phase 1 Unit in February 2005 (as described in the Technical Staff Report for CAO R9-2006-0016 referenced above).

Conditions of ponding leachate on the operations layer of the Phase 1 Unit may: a.) contribute to the creation of unauthorized discharges (leaks) of leachate from the base of the Unit, and b.) create unstable conditions within the existing 250,000 cubic yards of waste, which would serve as the proposed foundation of the USMC’s engineered remedial alternative for the Phase 1 Unit. Saturated waste conditions in the basal portion of the Unit may create a significant threat to water quality by increasing instability of the Unit and affecting the long-term integrity of the waste containment system for the Phase 1 Unit.

- c. Project specifications (prepared by EMCON) required that the geosynthetic clay liner (GCL) be installed in direct and uniform contact with the underlying subgrade materials. The existing evidence indicates that the subgrade is rocky and uneven, with rocks approximately 8-inches in length, creating holes/punctures in the synthetic components (GCL and HDPE) of the liner system. Continued waste disposal operations in Phase 1 will contribute a greater load that is likely to create more severe permanent defects in the existing basal liner system of the Phase 1 Unit.

- d. Project specifications (prepared by EMCON) required the high density polyethylene (HDPE) geomembrane to be installed above the GCL, and below the geotextile. The geomembrane was to be installed in uniform contact with the underlying and overlying liner components. The exposed HDPE surface includes shallow undulations up to 1-inch due to improper subgrade conditions. At one test location, the HDPE was observed to be suspended, or "bridged" approximately 8 inches over the underlying GCL and subgrade. The Regional Board concludes that the documented defects in the existing basal liner components will not allow the existing basal liner system to function as required in Order 2000-54.

The continued existence of the defects in the liner system and operations layer, and conditions described above are likely to create additional and more severe permanent defects, with the discharge of an additional 100+ feet of waste into the Unit, in the existing basal liner system of the Phase 1 Unit.

#### 4. **Proposed alternative remedial action implementation,**

The CAP provides a description of the proposed alternative remedial action for "Portions of the Phase 1 WMU Footprint Already Covered by Waste Placement" and as illustrated in Figures 2-1 and 2-2 of the CAP. The description indicates the USMC's intent to *"Construct a new composite liner system/LCRS on top of the intermediate cover. The liner/LCRS will be identical to the Phase 1 WMU floor liner system described in Order No.2000-54....,"*

It is not clear to the Regional Board that the original liner design described in Order 2000-54, and installed as envisioned by the USMC's Alternative Remedial Action described in the CAP, could meet the required performance or stability criteria required by the applicable waste discharge requirements (Order No. 2000-54), CCR Title 27, CFR Title 40, Part 258, or State Board Resolution No. 93-62. The original liner system was evaluated for installation on a graded surface of bedrock not an underlying layer of solid wastes (see Specific Comment No. 1 above). The CAP does not include sufficient information for the USMC to support their alternative remedial action by making the required demonstrations pursuant to CCR Title 27, §20080(b)(2) and Directive 4 of CAO R9-2006-0016.

The Alternative Remedial Action approach would continue loading the existing Phase 1 waste mass with more than 100 feet of new solid waste. The existing waste mass is immediately underlain by an operations layer with very low permeability due to very high fines content. From the information provided by Brown and Caldwell (2003) and ERRG (2004), it appears likely that leachate is impeded from flowing into the underlying LCRS and may be ponding within the

existing waste mass in Phase 1 Unit. Under these conditions, the base of the waste mass may be saturated, but to an unknown depth. Saturated conditions typically reduce design stability and loading of the Unit can further reduce stability. Lateral spreading failures can occur when saturated foundation materials are loaded, particularly when loaded rapidly. Rapid loading creates excess pore pressure in saturated foundations which must be allowed to dissipate to avoid failure. The CAP fails to provide results from an engineering stability analysis to address the suitability of the existing Phase 1 waste mass as a foundation for more than 100 feet of additional waste and 4 feet of cover.

The Alternative Remedial Action plan presents significant potential problems with respect to short and long term foundation stability, waste containment, and disruption of intermediate containment features due to differential settlement. Differential settlement could be a very significant depending on the density of the existing Phase 1 waste mass. The CAP fails to provide technical information to evaluate the problem of differential settlement stating only that settlement "will be accommodated."

The estimated performance of the Alternative Remedial Action plan relies on the assumption that the existing Phase 1 liner system "will remain functional." This is highly improbable since evidence exists indicating that the Phase 1 Unit subgrade and liner system are defective, and the operations layer was not built according to design specifications, and is not currently functioning in compliance with the applicable requirements. The potential problems described herein may lead to extensive environmental damage and require expensive clean-up. Therefore, the Regional Board does not consider the Alternative Remedial Action plan to be "equally protective" compared to the Clean Closure plan as is claimed in the CAP. The Clean Closure option would eliminate all potential problems associated with leaving the Phase 1 waste mass in place and is therefore considered preferable. Compared with the Alternative Remedial Action plan, the Clean Closure approach provides far superior environmental protection.

The CAP asserts (pages ES-1, 2-1 and A-5) that the Remedial Action Alternative benefits from containment provided by a "*double liner*," while the design indicates use of a single composite liner. The "*double liner*" of the Remedial Action Alternative plan apparently consists of two single composite liners separated by approximately 30 feet of existing waste. The Regional Board does not agree with the assertion that the proposed design will function as a "*double liner*" and anticipates that the proposed remedial design would not provide waste containment advantages equivalent to a properly designed and constructed double liner system.

The proposed Alternative Remedial Action has the potential to result in extensive environmental damage as well as high clean-up costs resulting from

foundation failure and/or differential settlement. The CAP does not consider these environmental impacts or the associated cost of clean-up. Clean Closure can be augmented by transfer of existing Phase 1 solid waste to an adjacent newly constructed Phase 2 Unit.<sup>1</sup>

5. **Enhancement of monitoring systems.** The CAP does not include significant information about necessary or desirable modifications to the existing monitoring systems (e.g., for leachate, landfill gas, groundwater, surface water, etc.) for the Las Pulgas Landfill, resulting from implementation of the USMC's preferred remedial alternative for the Phase 1 Unit.
6. **TABLE 2-2: Cost Comparisons for remedial alternatives.**

The CAP proposes to implement an engineered remedial alternative that must meet the minimum requirements of Directive B.4 in Order R9-2006-0016, as follows:

- a. **Technical Feasibility.** *The CAP shall establish to the satisfaction of the Regional Board that implementation of Directive B.1.a. or B.1.b. of this Order is not feasible by providing an acceptable demonstration that:*
  1. *Compliance with Directives B.1.a. or B.1.b. is unreasonable and unnecessarily burdensome and will cost substantially more than the proposed remedial action(s); or*
  2. *Compliance with Directives B.1.a. or B.1.b. is impractical and will not promote attainment of the applicable requirements of CCR Title 27 and Order No. 2000-54 "Waste Discharge Requirements for the U.S. Marine Corps, Marine Corps Base Camp Pendleton, Las Pulgas Landfill, San Diego County" and addenda thereto.*

Groundwater pollution from the Las Pulgas Landfill [see Remedial Investigation for Group B sites (1994) and ROD for OU2 sites (1997)] appears to pre-date the construction of the Phase 1 Unit. The Phase 1 Unit began waste management and disposal operations during the 1999 to 2000 time frame.

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<sup>1</sup> The USMC may wish to consider developing a JTD to propose a replacement Unit to be constructed within the footprint of the "clean closed" Phase 1 Unit. Construction of the liner system in the new Phase 2 Unit, and any replacement Unit for Phase 1, should be followed by a leak detection survey. Leak detection surveys can be very effective at detecting flaws (holes) in the newly constructed liner thereby enhancing the protection of water quality by significantly reducing potential liner leakage resulting construction related defects.

It is not clear how the CAP develops tasks, assumptions, and specific estimated costs associated with excavating the existing wastes in the Phase 1 Unit and discharging those wastes into the Phase 2 Unit as previously discussed with the USMC (see General Comment No. 4 above). Under the corrective construction and/or clean closure options, the availability of the Phase 2 Unit would allow the USMC to significantly reduce the costs and logistical problems associated with managing/handling and disposal of the wastes from the existing Phase 1 Unit. It is the understanding of the Regional Board that the USMC plans to construct the Phase 2 Unit adjacent to the existing Phase 1 Unit at the Las Pulgas Landfill. Under this scenario, significantly reducing the costs of waste management and disposal from the Phase 1 Unit could be achieved by effectively coordinating the completion of construction for the Phase 2 Unit. It is not clear what, if any, portion of the wastes from the Phase 1 Unit would require off-site disposal.

The CAP fails to specify the considerations leading the USMC to conclude that excavation and removal of 24,000 cubic yards of subgrade (at \$100,000) would be necessary to attain clean closure of the Phase 1 Unit. This task and cost seem to assume that the subgrade is significantly and pervasively contaminated by waste constituents. A more realistic scenario would be that a limited amount of the subgrade material would require excavation and disposal.

The CAP fails to justify the task/cost for leachate collection and seep control piping (at \$30,000) and leachate sump (2 sumps/pumps /6,000 gal poly tank) (at \$30,000) is required for clean closure.

The clean closure option includes a task/cost for cover soil (at \$200,000). The CAP fails to justify the cost for cover soil after the USMC has removed all the waste and contaminated materials as required for clean closure pursuant to CCR Title 27.

The implementation of the USMC's preferred remedial action would require significantly higher financial assurances to address the additional risks associated with the long-term management operations and containment of wastes in the Phase 1 Unit, including, but not limited to, the following reasonably foreseeable conditions:

- a. Failure of the Unit to contain wastes, waste constituents and waste degradation products due to instability of the waste containment system and/or foundation, as described in General Comment No. 3, and Specific Comment Nos. 1 and 2 above.
- b. Progressive leakage of leachate and landfill gases, from the existing 250,000 cubic yards of wastes, through defects in the existing composite liner system (i.e., see General Comment No. 1 and Specific Comment No. 3 above), and

- long-term ponding of leachate upon the operations layer within the Phase 1 Unit. The CAP does not contain an estimate of costs/financial assurances that may be associated with cleanup and abatement of pollution and/or nuisance conditions associated with future discharges of waste constituents and degradation products from developing and worsening defects in the waste containment system of the Phase 1 Unit.
- c. Failure of the USMC's proposed second remedial alternative liner system (including the LCRS) from effects of differential settlement of the wastes and long-term ponding of leachate within the waste column of the Phase 1 Unit,
  - d. Failure of the USMC's proposed remedial alternative liner system, from impacts by differential settlement of the foundation (existing wastes), and ground motions from earthquakes upon the stability of the proposed remedial alternative design of the Phase 1 Unit.
  - e. Long-term ponding of leachate upon the existing operations layer of the Phase 1 Unit. Saturation of wastes above the existing operations layer, in the basal layer of the Unit, may contribute to long-term instability of the overall waste containment system for the Phase 1 Unit.

Costs of potential additional corrective actions due to failures associated with leaving Phase 1 waste in place are not factored into estimated costs for implementation of the Alternative Remedial Action plan. Disruption or failure of the Phase 1 Unit could create failures that compromise the integrity of the waste containment and conveyance systems leading to significant environmental damage and threats to water quality.

## 7. **TABLE 2-1: Cost Benefit Analysis of Alternative Corrective Actions**

Ratings and relative benefits of the three remediation plans listed on the table appear to ignore some comparative factors such as feasibility and constructability of the Alternative Remedial Action plan regarding potential impacts from slope stability and settlement problems.

## 8. **APPENDIX A: Evaluation of Corrective Action Alternatives**

Alternative 2: Clean Closure.

*Long-term effectiveness (page A-4):* The Regional Board does not agree with the USMC's conclusion on the long-term effectiveness for the clean closure option. The text states: "However, as the future phases of the landfill develop, Phase 1 clean closed footprint will become an unlined depression impeding surface water drainage and acting as a sump for leachate from the adjacent

*waste piles.*” See General Comment No. 2 above regarding the long-term status of a clean closed Phase 1 Unit.

9. **HELP Modeling Output for remedial alternatives evaluated in the CAP.**

The CAP identifies three remedial action plans: Corrective Construction, Clean Closure, and Alternative Remedial Action. Of the three, the CAP asserts that the Alternative Remedial Action is the most environmentally sound and cost effective approach. An environmental assessment was performed using the HELP model, and the three plans were rated based on estimated leakage through the liner system.

The Regional Board has the following concerns regarding the HELP modeling results presented in the CAP:

- a. The rate of leakage used in the HELP model is based on the number of assigned liner defects (holes) per acre of liner. The CAP erroneously assigns a liner leakage rate and associated environmental damage potential to the “Clean Closure” option when comparing it with the Alternative Remedial action plan. However, Clean Closure itself does not involve any long term environmental impact potential.
- b. Attachments: HELP Modeling Output

The HELP model simulations for “*clean closure*” (see “Clean Closure with Las Pulgas Design” and “Clean Closure with Title 27 Prescriptive Liner”) appear to include a composite liner system in the scenario for clean closed Phase 1 Unit. Clean closure under CCR Title 27 §21090(f) includes removal of “*all wastes materials, contaminated components of the containment system and affected geologic materials....*” The stated objective of clean closure is to “*.... render the landfill ... no longer capable of posing a threat to water quality.*”

Under the conditions described in CCR Title 27 §21090(f), assuming that wastes or contaminated material do not remain in-situ, the CAP fails to provide any rationale for why the clean closed Phase 1 Unit would require a “liner system” to be in place.

- c. Table C.3-1 and Attachments for HELP Modeling Output:

The table classifies the existing Phase 1 operations layer material as SC (sandy clay), and the CAP states on page 2-12 that the hydraulic conductivity (saturated) of the operations layer is  $3.9 \times 10^{-4}$  cm/sec according to ERRG (2006). The assumed permeability data do not appear to be consistent with a soil consisting of 42% clay.

The CAP does not provide the Regional Board with a convincing demonstration that the HELP modeling results, including the existing operations layer, accurately simulates conditions resulting from permeability characteristics of this layer. The permeability of the existing Phase 1 Unit operations layer was previously characterized and reported to the Regional Board in the following technical references:

**Engineering Remediation Resources Group (ERRG) report 1** ("Liner and Leachate Collection and Removal System Evaluation for Las Pulgas Landfill", dated November 2004a, page 3-1) reports that the "operations layer" had the following characteristics:

- i. 9.9% gravel, 58.5% sand, and 31.6% fines (minus #200 sieve).
- ii. remolded sample of operations layer had permeability results from the ranging from  $5.2 \times 10^{-5}$  to  $6.3 \times 10^{-5}$  cm/s.

**ERRG report 2** ("CQA Report Liner, Leachate Collection and Removal System Phase 1 Construction Las Pulgas Landfill", date November 2004b: see Table 2), characterizes the results from the sieve ops layer soil as "100% passing #4 sieve and 42.5 % passing #200 sieve."

**Brown and Caldwell Report** ("Technical Evaluation of Soil Slumping and Geosynthetic Liner Damage and CQA Report for Liner Repairs Las Pulgas Landfill", dated November 2003: page 2-9), confirms the sieve analysis results for the operations layer: "According to Ninyo and Moore gradation test results and sieve analysis data sheets, the operation soil layer consists of a silty fine sand (USCS SM) with more than 42.5 percent fines (e.g., passing No. 200 sieve)...." This information seems to confirm the fines content of the operations layer as reported in the report by EERG (2004a).

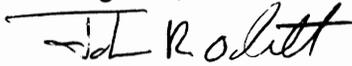
The Regional Board concludes that the HELP model simulation is unlikely to accurately simulate the effects of leachate permeability through the existing operations layer. The laboratory results for the existing operations layer, as reported by ERRG (2004b), appear to be almost an order of magnitude lower than the permeability used in HELP model simulations presented in the CAP.

The heading portion of this letter includes a Regional Board code number noted after "In reply refer to:" In order to assist us in the processing of your correspondence, please include this code number in the heading or subject line portion of all correspondence and reports to the Regional Board pertaining to this matter.

February 23, 2007

If you have any questions regarding this letter, please contact Ms. Amy Grove at (858) 637-7136 or via e-mail at [agrove@waterboards.ca.gov](mailto:agrove@waterboards.ca.gov).

Regards,



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Land Discharge Unit

cc: Mr. Mark Bonsavage, Office of the Chief of Staff - Environmental Security, P.O. Box 555008, Building 22165, Camp Pendleton, CA 92055-5008

Ms. Tracy Sahagun, Office of the Chief of Staff - Environmental Security, P.O. Box 555008, Building 22165, Camp Pendleton, CA 92055-5008

Ms. Rebecca Lafreniere, County of San Diego, Local Enforcement Agency, 9325 Hazard Way, San Diego, CA 92123

#### REFERENCES CITED

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**Engineering/Remediation Resources Group (ERRG), 2004a**, Liner and Leachate Removal Collection and Removal System Evaluation, Las Pulgas Landfill, Marine Corps Base Camp Pendleton, dated November 2004.

**Engineering/Remediation Resources Group (ERRG), 2004b**, Construction Quality Assurance Report Liner, Leachate Collection & Removal System Phase I Construction, Las Pulgas Landfill, Marine Corps Base Camp Pendleton, dated November 2004

**Tchobanoglous, G., H. Theisen and S. Vigil, 1993**, *Integrated Waste Solid Waste Management: Engineering Principles and Management Issues*, Boston: Massachusetts, Irwin-McGraw-Hill, 978p.

**Tetrattech, EC., Inc., 2006**, Corrective Action Plan, December 26, 2006, Phase I Expansion Unit Las Pulgas Landfill, Marine Corps Base, Camp Pendleton, California, DCN: ECSD-RACIV-07-0276.

## APPENDIX A

### Pollutants in municipal solid wastes (from Tchobanoglous et al, 1993).

Typical leachate composition from solid wastes in non-hazardous municipal landfills includes the following characteristics (from Tchobanoglous *et. al.*, 1993):

Constituent <sup>a</sup>	Units of Concentration in mg/L	
	New Landfill (< 2years)	Mature Landfill (>10 years)
5-day biological oxygen demand (BOD <sub>5</sub> )	2,000 to 30,000	100 to 200
Total Organic Carbon (TOC)	1,500 to 20,000	80 to 160
Chemical Oxygen Demand (COD)	3,000 to 60,000	100 to 500
Total Suspended Solid (TSS)	200 to 2,000	100 to 400
Organic Nitrogen	10 to 800	80 to 120
Ammonia Nitrogen	10 to 800	20 to 40
Nitrate	5 to 40	5 to 10
Total Phosphorous	5 to 100	5 to 10
Ortho Phosphorus	4 to 80	4 to 8
Alkalinity as CaCO <sub>3</sub>	1,000 to 10,000	200 to 1,000
pH	4.5 to 7.5	6.6 to 7.5
Total Hardness as CaCO <sub>3</sub>	300 to 10,000	200 to 500
Calcium (Ca)	200 to 3,000	100 to 400
Magnesium (Mg)	50 to 1,500	50 to 200
Potassium (K)	200 to 1,000	50 to 400
Sodium (Na)	200 to 2,500	100 to 200
Chloride (Cl)	200 to 3,000	100 to 400
Sulfate (SO <sub>4</sub> )	50 to 1,000	20 to 50
Total Iron (Fe)	50 to 1,200	20 to 200

<sup>a</sup> = This table from Table 11-13 of Tchobanoglous et al, 1993.

Further, the municipal solid wastes may include the following characteristics:

1. The presence of a number of chlorinated aliphatic and aromatic organic compounds (volatile organic compounds or VOCs), including: tetrachloroethene (PCE), trichloroethene (TCE), isomers of dichloroethene (DCE), and dichloroethane (DCA), vinyl chloride, and aromatic compounds such as benzene, toluene, ethylbenzene, xylenes (collectively known as BTEX compounds).

2. Landfill gas (LFG) from the decomposition of the municipal solid wastes in the Unit. The Regional Board staff reviewed published information (Tchobanoglous et al., 1993) to evaluate the composition of potential landfill gases from the Las Pulgas Landfill:

Landfill Gas Components	Percent Landfill Gas <sup>a</sup>
Methane	45 – 60
Carbon dioxide	40 – 60
Nitrogen	2 – 5
Oxygen	0.1 – 1
Hydrogen	0 – 0.2
Sulfides, disulfides, mercaptans, etc.	0 – 1
Ammonia	0.1 – 1
Carbon monoxide	0 – 0.2
Trace constituents	0.01 – 0.6

NR = category not reported by reference

a = data from Tchobanoglous et al., 1993 (pages 382 to 384)

Further, Tchobanoglous et al., 1993: (pages 384: Table 11-4) includes a description of “Trace constituents” category derived from a survey of 66 California municipal solid waste landfills, as follows:

Compound	Concentration in ppbV <sup>a</sup>		
	Median	Mean	Maximum
Acetone	0	6.8	24,000
Benzene	932	2,057	39,000
Chlorobenzene	0	82	1,640
Chloroform	0	245	12,000
1,1 – Dichloroethane (DCA)	0	2,801	36,000
Dichloromethane	1,150	25,694	620,000
1,1 – Dichloroethene (DCE)	0	130	4,000
Diethyl chloride	0	2,835	20,000
trans- 1, 2- Dichlorethane (DCA)	0	36	850
Ethylene dichloride	0	59	2,100
Ethyl benzene	0	7,334	87,500
Methyl ethyl ketone (MEK)	0	3,092	130,000
1,1,1- Trichloroethane (TCA)	0	615	14,500
Trichloroethylene	0	2,079	32,000
Toluene	8,125	34,907	280,000
1,1,2,2 - Tetrachloroethane	0	246	16,000
Tetrachloroethylene (PCE)	260	5,244	180,000
Vinyl chloride	1,150	3,508	32,000
Styrenes	0	1,517	87,000

Vinyl acetate	0	5,663	240,000
Xylenes	0	2,651	38,000

a = parts per billion by volume

The Regional Board concludes that municipal solid wastes (MSW) in the Phase 1 Unit at the Las Pulgas Landfill, and their degradation products, contain waste constituents/pollutants in significant concentrations. If those municipal solid wastes and their degradation products are not properly contained by the Unit, then the discharge of such wastes creates a significant threat to water quality by creation of conditions of pollution and/or nuisance affecting the designated beneficial uses of water resources.